**Development of Indium-Free Transparent Conductive Films by the Sol-Gel Method**

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**Motivation**

**The Project**
- **Problem:** Increasing demand for indium tin oxide (ITO), decreasing resources, high price
- **Aim:** Finding an alternative to ITO as standard for transparent conductive coatings (TCCs), e.g. for displays and solar cells
- **Approach:** Low cost sol-gel process, using widely available metallic elements and recent advantages in nanostructured coatings
- **Potential ITO Substitute:** Titanium dioxide based material, doped
- **Desired outcome:** Process route to fabricate a printable ink and low temperature sintering process for conductive coatings on glass and plastic substrates

**Results**

**Coated Glass Slides**
- Coated glass slides show interference colours
- Colours correlate with concentration of precursor (further studies needed)

**XRD-Analysis**
- Sintering at temperatures below 600°C yields amorphous structure (left), above 600°C TiO\(_2\)-anatase peak forms

**Microstructure**
- Multi-coating process leads to surface defects
- Coating is very porous, connectivity needs to be improved
- Nanoparticles are clearly visible (Figure 9 on right side)

**Sol-Gel Process**

**The Chemistry**
- Structure of products depends on reaction rates
  - Influenced by nature and concentration of metal, catalyst, solvent as well as temperature and pH value of solutions
- Aim: Formation of a crosslinked polymeric network

**Conclusion and Future Work**

**Summary**
- Interference colours suggest that coating was formed
- XRD patterns showed formation of desired TiO\(_2\) anatase structure for sintering temperatures above 600°C
- SEM micrographs indicate porous coating with embedded nanoparticles

**Next Steps**
- Vary reaction conditions
  - pH, solvent, precursor, water
- Define degree of cross linking in solution and coating
- Optimise drying/curing step (temperature, atmosphere)
- Determine conductivity of coatings
- Change doping levels

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**References**


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